REMARKS

Applicant requests favorable reconsideration and allowance of the subject application in view of the preceding amendments and the following remarks.

To place the application in better form, Applicant submits herewith a substitute specification, which includes a new abstract. For the Examiner's convenience, also provided is a marked-up copy of the original specification showing the portions thereof which are being changed. The substitute specification includes the same changes as are indicated in the marked-up copy. Applicant's undersigned attorney has reviewed the substitute specification and submits that the substitute specification contains no new matter.

Claims 15-28 are presented for consideration in lieu of claims 1-14, which have been canceled without prejudice or disclaimer. Claims 15 and 22 are independent. Support for these claims can be found in the original application, as filed. Therefore, no new matter has been added.

Applicant requests favorable reconsideration and withdrawal of the objections and rejection set forth in the above-noted Office Action.

The Examiner objected to the drawings and specification on formal grounds. Specifically, the Examiner asserted that reference numeral 6, shown in Figures 1, 2 and 5, was not discussed in the subject specification. This matter has been addressed in the substitute specification. In addition, the Examiner required that Figure 1 be labeled as "PRIOR ART." To expedite prosecution, Applicant submits herewith, by separate paper, a request for approval of a

drawing change to so label Figure 1. Applicant submits that these changes overcome the objections to the specification and drawings. Such favorable indication is requested.

Applicant notes with appreciation that claims 3, 4, 10 and 11 were indicated as containing allowable subject matter and would be allowed if rewritten in independent form. Applicant earnestly believes, however, that he is entitled to the protection afforded by independent claims 15 and 22, for example, as presented. The Examiner will note that these independent claims recite, among other features, that the second mark on the substrate on the second stage is positioned within a view of the second image sensing unit. This feature has been derived from claim 3, which was indicated as containing allowable subject matter. Applicant submits, therefore, that independent claims 15 and 22 should be deemed allowable. Accordingly, Applicant requests favorable reconsideration and withdrawal of the rejection set forth in the above-noted Office Action.

Claims 1, 2, 5-9, 13 and 14 were rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 6,577,382 to Kida et al. in view of U.S. Patent No. 6,544,805 to Holcman et al. Applicant submits that the cited art, whether taken individually or in combination, does not teach many features of the present invention, as previously recited in claims 1-14. Therefore, these rejections are respectfully traversed. Nevertheless, Applicants submit that claims 15-28, as presented, amplify the distinctions between the present invention and the cited art.

In one aspect of the present invention, independent claim 15 recites an exposure apparatus for aligning a substrate and performing exposure using the aligned substrate. The apparatus includes a first alignment system, having a first stage and a first image sensing unit, to

detect a position of a first mark on the substrate on the first stage using the first image sensing unit, a transfer system to transfer the substrate, on which the position of the first mark has been detected by the first alignment system, from the first stage onto a second stage, and a second alignment system, having the second stage and a second image sensing unit of which magnification is higher than that of the first image sensing unit, to detect a position of a second mark on the substrate on the second stage using the second image sensing unit, and to align the substrate based on the detection obtained by using the second image sensing unit. The first and second alignment systems and the transfer system are arranged such that the second mark on the substrate transferred on the second stage is positioned within a view of the second image sensing unit.

In another aspect of the present invention, independent claim 22 recites an alignment method of aligning a substrate. The method is adapted to an exposure apparatus for performing exposure using the aligned substrate. The method includes a first alignment step of detecting a position of a first mark on the substrate on a first stage using a first image sensing unit, a transfer step of transferring the substrate, on which the position of the first mark has been detected in the first alignment step, from the first stage onto a second stage, and a second alignment step of detecting a position of a second mark on the substrate on the second stage using a second image sensing unit of which magnification is higher than that of the first image sensing unit, and of aligning the substrate based on the detection obtained by using the second image sensing unit. The second mark on the substrate on the second stage is positioned within a view of the second image sensing unit through the first alignment step and the transfer step.

Applicant submits that the cited art, whether taken individually or in combination, does not teach or suggest such features of the present invention, as recited in independent claims 15 and 22.

The Kida et al. patent relates to a substrate transport apparatus that includes a transport arm for supporting a peripheral portion of a substrate at at least two places on the peripheral portion and transporting the substrate to a stage. The transport arm includes a first arm having a first support portion for supporting a rear face of one side of the peripheral portion of the substrate in a transport direction of the substrate and a first facing portion provided on the first support portion and facing a side face of the one peripheral portion of the substrate. A second arm has a second support portion for supporting a rear face of the other side of the peripheral portion of the substrate in the transport direction of the substrate and a second facing portion provided on the second support portion and facing a side of the other peripheral portion of the substrate. A drive mechanism drives each of the first arm and the second arm so as to approach and separate from each other.

The Examiner relies on the Holcman et al. patent for teaching a method for determining orientation of a wafer in which coarse alignment is used with lower magnification than that in fine alignment.

Applicant submits, however, that the cited art, whether taken individually or in combination, does not teach or suggest the salient features of Applicant's present invention, as recited in independent claims 15 and 22, including the feature that the second mark on the substrate on the second stage is positioned within a view of the second image sensing unit.

For the foregoing reasons, Applicant submits that the present invention, as recited in independent claims 15 and 22, is patentably defined over the cited art.

Dependent claims 16-21 and 23-28 also should be deemed allowable, in their own right, for defining other patentable features of the present invention in addition to those recited in their respective independent claims. Further individual consideration of these dependent claims is requested.

Applicant further submits that the instant application is in condition for allowance. Favorable reconsideration, withdrawal of the objections and rejection set forth in the above-noted Office Action and an early Notice of Allowance are requested.

Applicant's undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010 All correspondence should continue to be directed to our address given below.

Respectfully submitted,

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Marked-Up Substitute Specification

Application No. 10/762,372

TITLE OF THE INVENTION

EXPOSURE APPARATUS AND ALIGNING METHOD

FIELD OF THE INVENTION

[0001] The present invention relates to an aligning apparatus preferably applicable to reticle alignment in a semiconductor exposure apparatus.

BACKGROUND OF THE INVENTION

[0002] In a semiconductor exposure apparatus, the accuracy of alignment of a reticle and a wafer is significant in the performance, which directly influences the apparatus capability. In the exposure apparatus, a circuit pattern drawn on a reticle must be precisely overlaid on each shot area pattern on a wafer, and thus, different circuit patterns must be overlaid in multiple layers on the wafer. To obtain such high overlay accuracy, it is necessary to always accurately align the reticle and the wafer. Generally, in the exposure apparatus, the respective wafer and reticle substrates are aligned with their respective stages for high-accuracy alignment therebetween. For this purpose, the accuracy of alignment of the reticle and wafer stages is also significant.

[0003] For example, alignment of a reticle with the reticle stage is made by overlaying a reticle mark provided on a reticle lower surface on a reference mark provided on the reticle stage and measuring the overlaid marks. That is, the reticle is placed on the reticle stage, then the reticle and/or the reticle stage is moved to a position where a predetermined relative positional relation can be obtained between the reticle marks and the reference ~~mark, thereby~~ mark. Thereby, alignment is made.

[0004] Conventionally, a system to realize the above alignment has a construction as shown in Fig. 1. A reticle 5, supplied from a reticle transfer robot 1, is aligned based on an outer form shape by using thrust pins 3 in a reticle holder 2. Then, the reticle 5 is supplied by a reticle exchange hand 4 onto a reticle stage 10, and is aligned with the reticle stage 10. Numerals 20 and 21 denote measurement cameras and illumination LEDs for image sensing the reticle mark and a reference mark. An image processing unit 31 measures the positions of these marks using the obtained image data. The result of position measurement is used for reticle alignment. In this example, the result of the measurement is reflected in a reticle stage driver 11 through a control unit 32. A reticle holder 12 on the reticle stage 10, in the aligned state, holds the ~~reticle, thereby~~ reticle 6. Thereby, the alignment of the reticle is realized.

[0005] However, in an initial status of the above alignment, if the positions of the reference mark and the reticle mark are unknown, a search for the mark positions must be ~~performed, thus~~ performed. Thus, the throughput of the apparatus is seriously delayed. Generally, the position of the reference mark of the stage can be grasped by the apparatus ~~itself, however~~ itself. However, the position of the reticle mark differs by each reticle.

Accordingly, to improve the throughput of the apparatus, rough alignment, called prealignment, is performed so as to find the reticle mark position.

[0006] Japanese Published Unexamined Patent Application No. 2000-349022 proposes a system to efficiently realize this prealignment. According to the system, the prealignment is performed in parallel with setup processing such as inspection of reticle contamination and generation of ~~inventory, thereby~~ inventory. Thereby, the throughput is improved. However, in this system, as a ~~4-cell~~ four-cell detector fixed to a rotary part of a reticle exchange hand is used as a means for measurement of prealignment, the accuracy of alignment is the same on the reticle supply side and the reticle stage side. Further, in this system, it is difficult to attain high accuracy.

SUMMARY OF THE INVENTION

[0007] The present invention has ~~its~~ as an object to realize substrate alignment with high alignment accuracy so as to attain high throughput.

[0008] According to the present invention, the foregoing object is attained by providing an exposure apparatus which performs alignment on a substrate on first and second stages, and performs predetermined exposure processing using the substrate aligned on the second ~~stage, comprising~~ stage. The apparatus comprises: a first alignment unit to detect a position of a mark on a substrate placed on the first stage by using a first image sensing unit, and to perform alignment on the substrate based on the result of the detection; a transfer unit to transfer the substrate, aligned by the first alignment unit, from the first stage onto the

second stage; and a second alignment unit to detect the position of the mark on the substrate placed on the second stage by using a second image sensing unit having a higher magnification than that of the first stage, and to perform alignment ~~on~~ of the substrate based on the result of the detection.

[0009] Also, according to another aspect of the present invention, there is provided an aligning method for aligning a substrate by using first and second ~~stages, comprising:~~ stages. The method comprises a first alignment step of detecting a position of a mark on a substrate placed on the first stage by using a first image sensing unit, and performing alignment on the substrate based on the result of the detection; a transfer step of transferring the substrate, aligned ~~at~~ in the first alignment step, from the first stage to the second stage by a transfer unit; and a second alignment step of detecting the position of the mark on the substrate placed on the second stage by using a second image sensing unit having a higher magnification than that of the first stage, and to perform alignment ~~on~~ of the substrate based on the result of the detection.

[0010] Other features and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings, in which like reference characters designate the same name or similar parts throughout the figures thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

[0012] Fig. 1 is a schematic diagram showing reticle transfer and a reticle aligning mechanism in a general exposure apparatus;

[0013] Fig. 2 is a schematic diagram showing the reticle aligning mechanism according to a first embodiment of the present invention;

[0014] Fig. 3 is a schematic diagram showing the structure of a prealignment stage according to the first embodiment;

[0015] Fig. 4 is a graph showing a calculation of a correction amount according to the first embodiment;

[0016] Fig. 5 is a schematic diagram showing the reticle aligning mechanism according a second embodiment of the present invention;

[0017] Fig. 6 is a schematic diagram showing the structure of the prealignment stage according to the second embodiment;

[0018] Fig. 7 is a graph showing the calculation of the correction amount according to the second embodiment; and

[0019] Fig. 8 is a flowchart showing an exposure processing procedure according to the first embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] Preferred embodiments of the present invention will now be described in detail in accordance with the accompanying drawings.

[0021] In the embodiment described below, the present invention is applied to a reticle alignment mechanism in an exposure apparatus. In the exposure apparatus, prealignment for a reticle to be aligned is performed in parallel with an exposure processing operation, thereby, reticle exchange time is reduced, and high throughput is realized.

<First Embodiment>

[0022] Fig. 2 is a schematic diagram showing a reticle aligning mechanism according to a first embodiment of the present invention. As described above, the present embodiment is applied to an exposure apparatus, however, for the purpose of detailed explanation of the reticle aligning mechanism, elements of the exposure apparatus such as a projection optical system and a wafer stage are omitted in Fig. 2.

[0023] In addition to the conventional construction as shown in Fig. 1, a stage 30 for prealignment, image sensing units 40 and illumination LEDs 41 constituting an image sensing mechanism are provided. Note that the reticle transfer robot 1 is omitted from the figure. Further, the image sensing units 20 and the illumination LEDs 21 will be referred to as a first image sensing mechanism, and the image sensing units 40 and the illumination LEDs 41, as a second image sensing mechanism. The prealignment stage 30 is a stage driven

by, e.g., an XYθ ~~3-axis~~ three-axis linear motor. The image sensing units 20 and 40 are, e.g., CCD cameras. The first image sensing mechanism (20, 21) and the second image sensing mechanism (40, 41) are fixed on the same non-movable element (not shown). Thus, the reference positions of ~~the~~ both image sensing units (20, 40) are fixed to predetermined measurement coordinate positions, such as measurement centers of cameras.

[0024] The reference positions on the reticle holder 12 on the reticle stage 10 are brought into correspondence with the reference position of the image sensing units 20, and the reference positions on the reticle holder 2 on the prealignment stage 30 are brought into correspondence with the reference positions of the image sensing units 40. Thus, the relative positions of the reticle holder 2, holding the reticle 6, and the reticle holder 12, are clearly obtained.

[0025] Fig. 8 is a flowchart showing reticle alignment processing in the exposure apparatus according to the first embodiment.

[0026] First, at step S1, a reticle 5 to be used in exposure processing is transferred onto the reticle holder 2 by the robot 1. At step S2, alignment is performed based on an outer form shape of the reticle 5 with the thrust pins 3. At step S3, detection of reticle marks and rough alignment (prealignment) are performed by the second image sensing mechanism (40, 41) and the prealignment stage 30. ~~These~~ The reticle transfer processing at step S1 and the prealignment processing at steps S2 and S3 can be performed in parallel with alignment of the reticle 6 on the reticle stage 10 and exposure processing (steps S11 and S12).

[0027] At the timing of reticle exchange, the process proceeds from step S4 to step S5, at which, the pre-aligned reticle is transferred from the prealignment stage 30 to the

reticle stage 10 by the reticle exchange hand 4. When the reticle transfer by the reticle exchange hand 4 has been completed, as a used reticle (i.e., a reticle that was subjected to exposure) is placed on the prealignment stage 30, the used reticle is unloaded by the robot 1 (not shown in Fig. 2) at step S6. Thereafter, the process returns to step S1, at which rough alignment is performed on the next reticle. On the other hand, on the reticle stage 10, accurate alignment is performed on the reticle transferred at step S5. That is, at step S11, high-accuracy reticle alignment is realized by the first image sensing mechanism (20, 21). Then, at step S12, the reticle stage 10 moves the aligned reticle to an exposure processing position, and exposure processing is performed on the reticle. When the exposure has been completed, the reticle is returned to the reticle alignment position (the position of reticle transfer from the prealignment stage 30) at step S13, and the reticle exchange hand 4 is notified that transfer is possible.

[0028] The reticle exchange hand 4 unloads the used reticle from the reticle stage 10 in response to the notification, and loads a prealigned reticle onto the reticle stage 10 (steps S4 and S5).

[0029] ~~Hereinbelow, the~~ The reticle alignment will now be described in more detail.

[0030] First, the reticle transferred by the robot 1 to the reticle holder 2 at step S1 is aligned based on the outer form shape with the thrust pins at step S2. Fig. 3 shows the structure of the reticle holder 2. The reticle alignment with the thrust pins is made by, e.g., with [[3]] three pins 3a as reference pins, and two pressing [[2]] pins 3b to the reticle end surfaces. The purpose of the alignment with the thrust pins is bringing the reticle into a predetermined range without measurement of the position of the reticle marks ~~position~~, for

efficient prealignment by image sensing. For this purpose, it is desirable that the positional relation between the [[2]] two sides to abut against the [[3]] three reference pins 3a and the reticle marks are obtained in advance as reticle information. After the alignment based on the outer form shape with the thrust pins, the reticle holder 2 holds the reticle by, e.g., vacuum clamping the lower surface of the reticle, then the process proceeds to the prealignment at step S3.

[0031] To detect the reticle marks aligned based on the outer form shape with the thrust pins without search, the image sensing unit 40 has a wide-view detection range in consideration of the accuracy of the thrust pins 3 and reticle-mark drawing error in each reticle, so as to reliably detect the reticle marks after the execution of step S2. The reticle marks are measured by the second image sensing mechanism (40, 41), and the reticle marks are aligned to reference positions (predetermined camera measurement coordinate positions) 42 and 43.

[0032] The correction amount in alignment is calculated as shown in Fig. 4. "XYθ" is calculated from the relative positions of the measurement coordinates 42, 43 as the reference position measured by the image sensing units 40 and the reticle marks 44 and 45. Note that "O'" denotes a center of a line segment connecting the reticle marks 44 and 45. The value "XYθ" is reflected in the prealignment stage 30 through the control unit 34, thereby, the prealignment stage moves so as to bring the reticle marks to the reference positions. Thus, the prealignment is completed.

[0033] After the above rough alignment (prealignment), the reticle is transferred onto the reticle stage 10 by the reticle exchange hand 4 (step S5). At this time, if the amount of

driving of the reticle exchange hand 4 is always the same, the positions of the reticle marks on the reticle transferred onto the stage 10 can be measured in approximately the same positions each time. Accordingly, the second image sensing mechanism (40, 41) and the reticle holder 2 have reference positions as reference prealignment positions to bring the reticle marks into a predetermined positional range (the view range of the first image sensing mechanism) upon the reticle transfer by the reticle exchange hand 4. By this arrangement, on the reticle stage 10, as the reticle marks are positioned within the view of the first image sensing mechanism (20, 21) without search of reticle marks, high-accuracy alignment can be immediately performed. Preferably, the reference positions in the reticle holder 2 are brought into correspondence with, e.g., the camera center upon assembly. Further, if such previous setting is difficult, shift amounts from the camera center may be used as offset amounts. The coordinate positions shifted by the offset amounts can be set as reference positions.

[0034] When the reticle has been transferred by the reticle exchange hand 4, the reticle marks are image-sensed and measured on the reticle stage ~~10, thus~~ 10. Thus, the reticle is finally aligned (step S11). On the reticle stage 10 side, as the mark positions have been obtained by the previous prealignment, high-accuracy reticle alignment can be performed without search for reticle marks by the first image sensing mechanism (20, 21) having a narrower view and higher magnification than the second image sensing mechanism (40, 41). Actually, a shift occurs due to mechanical contact, or the like, upon transfer by the reticle exchange hand 4, and the shift amount can be corrected as an offset amount on the prealignment stage 30 or the reticle stage 10 side. Thus, the reticle alignment can be performed without losing the effect of the prealignment.

[0035] Note that the reticle marks measured at step S11 may by the same as or may be different from the reticle marks measured at step S3. That is, it may be arranged such that reticle marks for prealignment are different from reticle marks for final alignment for improvement in accuracy. In this case, the relative positions of the reticle marks used at step S11 and the reticle marks used at step S3 are clearly obtained in ~~advance, thereby~~ advance. Thereby, alignment can be performed without a search for a reticle mark, as in the case of the above embodiment.

[0036] Further, after the reticle alignment, the reticle stage 10 moves to the exposure position for execution of exposure processing, while the next reticle is transferred to the reticle holder 2. As described above, as prealignment is performed with the measured coordinate points as reference positions, the reticle marks can be detected without a reticle stage. Accordingly, the prealignment at steps S2 and S3 can be completed during the exposure at step S12. As a result, after the completion of exposure, when the reticle stage 10 returns to the alignment position, only the reticle exchange by the reticle exchange hand 4 and the reticle alignment at step S11 are performed. Thus, the reticle alignment can be very efficiently performed.

[0037] Note, that in the above embodiment, the reticle alignment has been ~~described, however~~ described. However, the present invention is applicable to wafer alignment, as well.

[0038] As described above, the aligning apparatus according to the first embodiment performs alignment on a first stage (prealignment stage 30, thrust pins 3 and reticle holder 2) and a second stage (reticle stage 10). The apparatus has a first alignment unit (thrust pins 3, image processing unit 33, control unit 34, and second image sensing mechanism 40, 41) to

perform alignment on a substrate placed on the first stage to bring marks (reticle marks) on the substrate to predetermined positions, a transfer device (reticle exchange hand 4) to transfer the substrate (reticle) from the first stage to the second stage, and a second alignment unit (image processing unit 31, control unit 32, and first image sensing mechanism 20, 21) to perform alignment with higher accuracy than that of the first alignment unit on the substrate placed on the second stage. The destinations of the marks on the substrate by the transfer device are known, and as the positions of the marks on the substrate are brought to the predetermined positions by the first alignment unit, the marks can be placed to positions appropriate to execution of alignment by the second alignment unit upon transfer of the substrate to the second stage. Thus, the alignment processing by the second alignment unit can be quickly performed. In a case ~~where~~ wherein the alignment apparatus is applied to an exposure apparatus, predetermined processing such as exposure processing is performed using the substrate placed on the above second stage. Then, the alignment by the first alignment unit can be performed on a substrate newly placed on the first stage during execution of the alignment by the second alignment unit and/or predetermined processing such as exposure processing.

[0039] In this arrangement, as prealignment can be completed during execution of predetermined processing such as exposure processing, the processing time for the substrate alignment can be reduced, and the throughput of the apparatus can be improved.

[0040] Further, the first alignment unit includes processing to perform alignment based on the outer form shape of the substrate. As the positions of the reticle marks can be brought into a predetermined range by using the outer form shape, the apparatus structure can

be simplified, and the processing speed can be increased. Note that it is necessary to previously obtain relative distances between the positions of reference points of the outer form shape and the mark positions to be measured.

[0041] Further, according to the first embodiment, the above first alignment unit performs alignment based on the outer form shape of a substrate (by using the thrust pins), then measures the marks of the substrate by image sensing, thereby ~~performs~~ performing alignment of the substrate. Especially, in the first embodiment, the first stage is driven based on the result of measurement of the image-sensed marks of the substrate such that the marks are brought to predetermined reference positions (the reticle stage 30 is moved in the XYθ direction).

[0042] Further, in the above-described transfer device, to reflect the result of alignment performed on the first stage (prealignment) on the second stage with high accuracy, the substrate holding position on the first stage (reticle holder 2) and the substrate holding position on the second stage (reticle holder 12) are linked with each other. As the relative positional relation between the reference positions of the respective holders are clearly obtained, efficient alignment without search for substrate marks can be realized on the second stage. Note that, since the linkage between the positions of ~~the~~ both reticle holders greatly influences the accuracy of mark alignment, it is preferable that reference positions of the image sensing mechanisms in the respective reticle holders are used. Further, as a mechanism to chuck the substrate in the reticle holder, a well-known chuck mechanism such as an electrostatic chuck or a vacuum chuck can be employed.

[0043] Further, the above linkage is made for the purpose of clearly obtaining the position to the reference position of the first image sensing mechanism (20, 21), upon the transfer of the substrate, pre-aligned to the reference positions of the second image sensing mechanism (40, 41) in the reticle holder 2, by the reticle exchange hand 4 to the reticle holder 12. As long as the relative position is clearly obtained, even if a positional shift occurs upon reticle transfer, the shift amount is used as an offset amount to the reference position of the reticle holder 2. Thus, the substrate can be approximately accurately transferred to the reference position of the reticle holder 12 (first image sensing mechanism 20, 21).

<Second Embodiment>

[0044] In the first embodiment, prealignment is realized by driving the prealignment stage 30 in the XYθ direction. In the second embodiment, prealignment is realized by fine driving of thrust ~~pins, thereby~~ pins. Thereby, the structure can be simplified.

[0045] Fig. 5 shows the reticle aligning mechanism according to the second embodiment. The present embodiment is also applied to an exposure apparatus. As in the case of the above embodiment shown in Fig. 2, for the purpose of a detailed explanation of the reticle aligning mechanism, elements of the exposure apparatus such as a projection optical system and a wafer stage are omitted in Fig. 5. The difference from Fig. 2 is that the prealignment stage 30 is not used, but thrust pins 50 (pins 50a to 50d as shown in Fig. 6), which can be finely driven, are used for prealignment.

[0046] Fig. 6 shows the details of the reticle thrust pins 50 shown in Fig. 5. The thrust pin 50a, provided on the Y axis of the measurement coordinate system, can be finely

driven in the X direction; the thrust pins 50b and 50c, provided on the X axis of the measurement coordinate system, can be finely driven in the Y direction; and the thrust pin 50d, having a spring mechanism between the pin and the driving portion, can absorb fine driving of the pins 50a, 50b and 50c, and distortion of the outer form shape of the reticle.

[0047] The entire flow of the exposure processing, including prealignment according to the second embodiment, is as described in the first embodiment (Fig. 8). In the second embodiment, the prealignment processing at steps S2 and S3 is different.

[0048] The prealignment according to the present embodiment is performed as follows. First, in a status where the reticle is placed on a stage for prealignment, the thrust pins 50 are moved to predetermined positions so as to abut against the ~~reticle, thus~~ reticle. Thus, the reticle is aligned based on an outer form shape.

[0049] Next, the reticle marks 44 and 45 are measured by the first image sensing mechanism (40, 41) while the reticle in the above status is held. In the second embodiment, the alignment correction amount is calculated as shown in Fig. 7. The correction amount X is reflected in the driving of the pin 50a; the correction amount Y1, in the driving of the pin 50b; and the correction amount Y2, in the driving of the pin 50c, through the image processing unit 33 and the control unit 34. As a result, the reticle marks 44 and 45 can be aligned with the reference positions 42 and 43. In the first embodiment, a rotational component is corrected in the θ directional driving ~~axis, however~~ axis. However, in the second embodiment, the rotational component is corrected by independently moving the pins 50b and 50c by correction amounts Y1 and Y2. All the correction amounts can be obtained from the differences between the reference positions 42, 43 and the reticle mark positions 44,

45. Further, as the correction directions and the operation directions of the driven parts are the same, the structure is intuitive.

[0050] In the second embodiment, as actuators are employed only for the [[4]] four axes of thrust pins, commonality of driving units for the thrust pins and prealignment can be ~~realized, thereby~~ realized. Thereby, further downsizing and weight reduction in comparison with the first embodiment can be attained. Further, in the second embodiment, [[2]] two measurement reference points and [[2]] two axes of Y-axis driving units are employed on the assumption of rotational ~~shift, however~~ shift. However, in a case ~~where~~ wherein correction of rotational shift is unnecessary, [[1]] one measurement reference point and [[1]] oneY-axis driving unit may be ~~employed, thereby~~ employed. Thereby, further downsizing and weight reduction can be made.

[0051] Further, in the sequence of the entire apparatus operation, merely the processing at steps S2 and S3 is ~~changed, thus~~ changed. Thus, the flow of reticle exchange is the same as that in the first embodiment. That is, the prealignment at steps S2 and S3 can be completed during exposure. Then, after the completion of exposure, when the reticle stage 10 returns to the alignment reference position, only the reticle exchange by the reticle exchange hand 4 and the final alignment at step S1 are ~~performed thereby~~ performed. Thereby, the reticle alignment is completed. Thus, very efficient reticle alignment can be realized.

[0052] As described above, according to the second embodiment of the first embodiment, the first stage, including the prealignment stage 30, the thrust pins 3 and the reticle holder 2, is constituted with the thrust pins 50 and the reticle holder 2. The image sensing and measurement are performed on the reticle ~~marks, then~~ marks. Then, based on the

result of the measurement, the reticle is further aligned based on the outer form shape (by using thrust pins) such that the marks are brought to predetermined reference positions. In the second embodiment, as the prealignment stage 30 can be omitted, the structure can be simplified.

[0053] As described above, according to the above respective embodiments, reticle alignment and prealignment can be realized with high alignment accuracy, without a search for a mark, and further, prealignment in parallel with an exposure operation can be realized. Accordingly, the entire throughput of the exposure apparatus can be improved.

[0054] As described above, according to the present invention, substrate alignment with high alignment accuracy to attain high throughput can be realized.

[0055] As many apparently widely different embodiments of the present invention can be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

WHAT IS CLAIMED IS:

1-14. (Canceled)

15. (New) An exposure apparatus for aligning a substrate and performing exposure using the aligned substrate, said apparatus comprising:

a first alignment system, having a first stage and a first image sensing unit, to detect a position of a first mark on the substrate on said first stage using said first image sensing unit;

a transfer system to transfer the substrate, on which the position of the first mark has been detected by said first alignment system, from said first stage onto a second stage; and

a second alignment system, having said second stage and a second image sensing unit of which magnification is higher than that of said first image sensing unit, to detect a position of a second mark on the substrate on said second stage using said second image sensing unit, and to align the substrate based on the detection obtained by using said second image sensing unit,

wherein said first and second alignment systems and said transfer system are arranged such that the second mark on the substrate transferred on said second stage is positioned within a view of said second image sensing unit.

16. (New) An apparatus according to claim 15, wherein the first mark and the second mark are the same.

17. (New) An apparatus according to claim 15, wherein said first alignment system aligns the substrate based on the detection obtained by using said first image sensing unit.

18. (New) An apparatus according to claim 15, wherein the second mark is positioned within the view by moving said second stage based on the detection obtained by using said first image sensing unit.

19. (New) An apparatus according to claim 15, wherein said first alignment system detects the position of the first mark on the substrate aligned based on an outer shape of the substrate.

20. (New) An apparatus according to claim 17, wherein said first alignment system drives said first stage so as to bring the first mark to a reference position.

21. (New) An apparatus according to claim 19, wherein said first alignment system comprises a member onto which an end face of the substrate is pressed.

22. (New) An alignment method of aligning a substrate, said method adapted to an exposure apparatus for performing exposure using the aligned substrate, said method comprising:

a first alignment step of detecting a position of a first mark on the substrate on a first stage using a first image sensing unit;

a transfer step of transferring the substrate, on which the position of the first mark has been detected in said first alignment step, from the first stage onto a second stage; and

a second alignment step of detecting a position of a second mark on the substrate on the second stage using a second image sensing unit of which magnification is higher than that of the first image sensing unit, and of aligning the substrate based on the detection obtained by using the second image sensing unit,

wherein the second mark on the substrate on the second stage is positioned within a view of the second image sensing unit through said first alignment step and said transfer step.

23. (New) A method according to claim 22, wherein the first mark and the second mark are the same.

24. (New) A method according to claim 22, wherein the substrate is aligned based on the detection obtained by using the first image sensing unit, in said first alignment step.

25. (New) A method according to claim 22, wherein the second mark is positioned within the view by moving the second stage based on the detection obtained by using the first image sensing unit.

26. (New) A method according to claim 22, wherein the position of the first mark on the substrate, aligned based on an outer shape of the substrate, is detected in said first alignment step.

27. (New) A method according to claim 24, wherein the first stage is driven so as to bring the first mark to a reference position in said first alignment step.

28. (New) A method according to claim 26, wherein the substrate is aligned by pressing an end face of the substrate onto a member in said first alignment step.

ABSTRACT OF THE DISCLOSURE

~~An aligning apparatus having a prealignment stage 30 and a reticle stage 10 performs reticle alignment. First, rough alignment is performed on a reticle placed on the prealignment stage 30 such that a reticle mark is brought to a predetermined position. A reticle exchange hand 4 transfers the reticle from the prealignment stage 30 to the reticle stage 10. On the reticle stage 10, an image processing unit 31, a control unit 32 and a first image sensing mechanism 20, 21 perform high-accuracy alignment on the reticle such that the reticle mark is brought to a predetermined position. The reticle aligned on the reticle stage 10 is subjected to exposure processing or the like.~~

-- An exposure apparatus for aligning a substrate and performing exposure using the aligned substrate. The apparatus includes a first alignment system, having a first stage and a first image sensing unit, to detect a position of a first mark on the substrate on the first stage using the first image sensing unit, a transfer system to transfer the substrate, on which the position of the first mark has been detected by the first alignment system, from the first stage onto a second stage, and a second alignment system, having the second stage and a second image sensing unit of which magnification is higher than that of the first image sensing unit, to detect a position of a second mark on the substrate on the second stage using the second image sensing unit, and to align the substrate based on the detection obtained by using the second image sensing unit. The first and second alignment systems and the transfer system

are arranged such that the second mark on the substrate transferred on the second stage is positioned within a view of the second image sensing unit. --